

Problems in Adaptation to Climate Change Effects on Coastal Agriculture by the Farmers of Patuakhali District of Bangladesh

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Abstract Climate change is the most serious environmental threat to the national economy of Bangladesh, essentially because of its impact on agriculture. The objective of this paper was to identify the major problems to climate change adaptation among farmers of coastal Bangladesh. The paper was based on primary data collected from 124 farming households selected randomly from the coastal region of Bangladesh. The data was analyzed using descriptive statistics with SPSS [17]. Slightly more than two fifth (42.75 percent) of the farmers had medium problem compared to 34.65 percent of them having low and 22.60 percent high problem were found in this area. The correlation coefficients of 6 variables were significant named age, farm size, farming experience, annual family income, organizational participation and agricultural knowledge. The major problems faced by the farmers adapting to climate change effects were – (a) the unpredicted weather and high frequency of natural calamities, (b) Non-availability of improved variety seeds at local market, (c) lack of information about adaptation strategies, (d) poor fertile land, (e) poor access to market of agro-products, (f) lack of irrigation facilities and schemes, (g) conflicts between fish cultivar and farmers, (h) scarcity and untimely supply of farm input, (i) limited farm size, (j) lack of credit, (k) Low annual family income, (l) Poor agriculture extension services, (m) Unavailability and high cost of farm labor at peak season etc. The paper concluded with the recommendation that farmers' adaptation capacities to climate change need to be strengthened by extension service so as to obtain sustainable agricultural production and food security even in the event of climate change. These supports could come from governments (GOs), non-governmental organizations (NGOs) and even from farmers' themselves.

Keywords: farmers, problems, climate change, agriculture, adaptation, extension

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1. Introduction

Agriculture, the backbone of Bangladesh economy, is highly dependent on climate. And climate is changing rapidly with its effects on agriculture, human health and all other living flora and fauna around the world. Bangladesh is the most vulnerable countries to climate change effects due to its geographical location. A climate change effect on agriculture is a great threat to Bangladesh to feed the huge population and to sustain its economic growth. Climate change has a major impact on agricultural production around the world. Especially countries in the tropics and subtropical zones, mostly developing economies, are expected to lose in terms of agricultural production. Many of these developing countries including Bangladesh are highly dependent on the production and exports of agricultural goods, climate change will therefore cause considerable losses of growth and export opportunities.

Bangladesh is located between 20°34' to 26°38' North latitude and 88°01' to 92°42' East longitude. The country

occupies an area of 147,570 sq. (BBS, 2012) [4]. Bangladesh is one of the most populated countries in the world having a coastal area of 47,211 sq. km. which is 32% of its entire land. Sixty two (62%) percent of the land has an elevation less than 3 meters and 86% have less than five meters (Mobassarul et al., 2009) [12]. The population of the coastal zone of Bangladesh was 36.8 million in 2001. Agricultural labourers, small farmers, fisher folk and the urban poor make up 71 percent of the 6.85 million households (Ahmad, 2004) [2]. Severe floods, cyclones, tornados are hitting every year; salinity and cold spell claims human lives as well as damage crops. According to experts these are early sign of global warming effects. Sea level rise in the coming decades will create over 25 million climate refugees (Climate Change Cell, 2007) [5]. According to UNFCCC (2005) [21] Bangladesh is one of the top risked countries in terms of natural disaster in the world.

The effects of climate change in Bangladesh are already seen, it is likely that changes include higher temperatures throughout the year and rainfall unpredictability leading to greater shortages of irrigation in some seasons and flooding in others [11,15,16,18].

In coastal areas of southern Bangladesh, it is likely that sea level rises will lead to increased salinity of groundwater, greater frequency of cyclones and storm surges (Karim and Mimura 2008) [10]. Climate change has increased the extent of monsoon flooding and threat to culture fishes has also increased under climate change (GOB, 2005) [6]. Cyclone and storm surge have both immediate and long term consequences on coastal agriculture (Uddin, 2012) [19]. According to the latest estimates, about 800,000 to 1300,000 MTs of paddy have been destroyed in SIDR which created severe food insecurity among the affected people (GoB, 2008) [7]. Shrimp culture in ghers both inside and outside embankments are threatened by high tides and flood (Howlader et al., 2015) [9]. Livestock also suffer large-scale death in cyclonic storm surge (Haider et al., 1991)[8].

Bangladesh has been ranked as the 3rd most vulnerable in the world to sea level rise in terms of the number of people living in the low elevation coastal zone. World Bank (2000) [22] estimated that by the year 2020, 2050 and 2100 the sea level of Bangladesh would increase 10 cm, 25 cm and 1 m. Sea level rise could potentially force around 33 million people to lose their home by 2050 and up to 43 million by 2080 (Mohal & Hossain, 2007) [13]. So it is clear that adaptation should be encouraged and subsidies to sustain the agriculture with a view to food security.

M.G.R. Akanda and M.S. Howlader (2015) [3] recommended in their study at same area as the coastal areas are relatively vulnerable to different hazards on

account of climate change, the physical infrastructure in such places is to be developed keeping in contemplation the effects caused by the climate change to change livelihood patterns across the coastal Bangladesh. Adaptation is inescapable to address the impacts of climate change but adaptation efforts are obstructed in many ways. Problems in adaptation to climate change effects on agriculture limit people's ability to identify assess and manage risks in a way that maximizes their food security.

2. Methodologies

The study area was two upazila namely Galachipa and Patuakhali Sadar under Patuakhali district of Bangladesh. The geographic location of the study area is 22.05-22.35°N and 90.15-90.43°E. Galachipa upazila has 13 unions from which Galachipa union And Patuakhali sadar upazila has 18 unions from which Lohalia union were selected randomly. From 17 villages of two unions 9 villages viz. Boalia, East Ratandi, Gorabala, Kalikapur, Pokkhia from galachipa, and Idrakpur, Kakrabunia, Najirpur, Palpara from Lohalia were selected randomly. Landless and absentee farmers were discarded from the farmers list with the help of SAAOs. Thus the sample population was 1240. Then 10 percent of the sample population from each village was selected separately as the sample of the study by simple random sampling procedure. Thus the sample size was 124.



Figure 1. Map showing the data collection site (Red Box) at Patuakhali District of Bangladesh

Data were collected by the researcher himself through face to face visit to all the selected farmers during 1st August, 2015 to 30th September, 2015. Four group

meetings also done to obtain more in-depth information from farmers on the subject matter. The collected data were systematically recorded, edited, arranged, compiled,

tabulated, computerized and analyzed in accordance with the objectives of the study. Different statistical treatments like frequency, range, mean, percentage, distribution, standard deviation, categories and indices etc. were used to describe, represent and explaining the relationships among the variables in this study with the help of SPSS software [17].

In the present study, ten selected characteristics namely age, education, farm size, farming experience, annual income, training experience, communication exposure, organizational participation, agricultural knowledge and fatalism were selected. Problems in adaptation to climate change effects on agriculture by the farmers were dependent variable. Data for the study were collected through a semi-structured interview schedule that was validated by experts in agricultural extension. A-four point rating scale was developed to measure the extent of problems in adaptation to climate change in affected areas ranked as "High", "Medium", "low" and "not at all" scored as 3, 2, 1, 0 respectively. The extent of problems in adaptation to climate change effects on coastal agriculture found by the farmers was computed by adding all scores obtained from problems in adaptation to climate change by respondents. On the basis of adaptation scores of the farmers were classified into three groups viz. "low problem", "medium problem", high problem". In identifying the difficulties farmers face in adapting to the impacts of climate change, in-depth literature reviews, and Expert opinions from Agriculture sector specialist and observations were utilized.

The enlisted problems are ranked based on their frequency cited by respondents. It was necessary to have an understanding about the problems faced by farmers in adapting practices. A Problem Facing Index (PFI) for selected 25 aspects was computed to serve the purpose by using the formula.

Problem Facing Index (PFI)

$$= (P_0 \times 0) + (P_1 \times 1) + (P_m \times 2) + (P_h \times 3)$$

Where,

P₀= Percentage of farmers facing no problem in adaptation

P₁ = Percentage of farmers facing low problem in adaptation

P_m = Percentage of farmers facing medium problem in adaptation.

P_h= Percentage of farmers facing high problem in adaptation.

3. Result and discussions:

3.1. Farmers Category Based on Problem Faced in Adaptation

The problem scores of the farmers ranged from 40 to 67 against the possible range of 0 to 75. The mean and standard deviation were 53.49 and 6.28 respectively. Slightly more than two fifth (42.75 percent) of the farmers had medium problem compared to 34.65 percent of them having low and 22.60 percent high problem were found in this area. Thus majority (63.35 percent) of the farmers has medium to high problem in adaptation.

3.2. Rank Order of the Problems Faced by the Farmers in Adaptation to Climate Change

Problem Facing Index (PFI) for any of the selected aspects could range from 0 to 372, where 0 indicating minimum adaptation and 372 indicating maximum adaptation. However, computed Problem Facing Index (PFI) ranged from 142-324.

Table 1. Rank order of the problems faced by the farmers in adaptation to climate change effects on coastal agriculture

Problems	PFI	Rank
Unpredicted weather and high frequency of natural calamities	324	1 st
Non-availability of improved variety seeds at local market	320	2 nd
Low annual family income	315	3 rd
Lack of credit facilities	312	4 th
Lack of salinity tolerant varieties for different crops	310	5 th
Lack of Disease and insect resistant varieties	308	6 th
Poor fertility of soil due to salinity	306	7 th
Scarcity and untimely supply of farm input	296	8 th
Lack of information about adaptation strategies	290	9 th
High illiteracy rate	287	10 th
Lack of fresh irrigation water and scheme	284	11 th
Poor access to market of agro-product	276	12 th
High input cost (improved seed, fertilizer, pesticide etc.)	270	13 th
Poor agriculture extension services	266	14 th
Unavailability and high cost of farm labor at peak season	262	15 th
Limited farm size	255	16 th
Lack of weather forecast information	248	17 th
Lack of fresh water during winter season for fish culture	240	18 th
Non-availability of storage and processing of agro-product	232	19 th
Low knowledge on ICM among farmers	218	20 th
Traditional practices/beliefs	193	21 st
Fatalistic behavior of the farmer	185	22 nd
Government irresponsiveness to monitoring climate risk management programmes	173	23 rd
Conflicts between crop farmer and fisherman for water management	164	24 th
No access to crop insurance	142	25 th

Table 2. Distributions of the respondents according to their socioeconomic characteristics

Characteristics	Categories	Number	Percentage	Mean	SD
Age	Young (up to 35)	27	21.80	44.33	8.80
	Middle aged (36-50)	63	50.80		
	Old (>50)	34	27.40		
Education	Illiterate (0)	15	12.10	4.96	3.68
	Can sign only(0.5)	27	21.80		
	Primary (1-5)	44	35.50		
	Secondary (6-10)	33	26.60		
	Above secondary(>10)	5	4.00		
Farm size	Small (.21-1.00 ha)	27	21.80	2.60	1.47
	Medium (1.01-3.00 ha)	67	54.10		
	Large (above 3.01 ha)	23	24.10		
Farming experience	Short (8-19)	38	30.60	24.35	8.28
	Medium (20-30)	56	45.20		
	Long (>30)	30	24.20		
Annual family income ('000' tk)	Low (90-200)	88	70.90	188.73	83.26
	Medium (201-300)	24	19.40		
	High (>300)	12	9.70		
Training experience	No (0)	33	26.62	12.44	10.09
	Short (1-12)	41	29.03		
	Medium (13-20)	31	25.00		
	Long (>20)	29	19.35		
Communication exposure	Low (19-29)	56	45.20	31.88	7.40
	Medium (30-40)	47	37.90		
	High (>40)	21	16.90		
Organizational participation	No (0)	27	21.80	7.41	5.17
	Low (1-7)	48	38.70		
	Medium (8-14)	36	29.00		
	High (>14)	13	10.50		
Agricultural knowledge	Low (up to 30)	27	21.80	32.94	2.80
	Medium (31-35)	78	62.90		
	High (>36)	19	15.30		
Fatalism	Low (27-33)	26	20.95	38.75	3.90
	Medium (34-40)	64	51.64		
	High (>41)	34	27.41		

Data presented in Table 2 indicate that Majority of the respondents were having low level of education (70.00 percent). Majority (78.20 percent) were aged 35 to 65 years, with farming experience ranging from 20 to 45 years (69.3%). Most of the farmers (76.80 percent) have medium to marginal farm size and majority of them belongs to low income (70.90 percent). About 26.62 percent of the respondents have no training experiences. Majority (60.50 percent) of respondents had low to medium organizational participation and most of the farmers (79.05 percent) are fatalistic in behavior. This also

relevant to the study by M.G.R. Akanda and M.S. Howlader (2015) [3].

Problems faced by the farmers in adaptation to climate change effects on coastal agriculture studied in the study. In order to know the relationship of the selected 10 characteristics (independent variables) of the farmers with the problems faced in adaptation to climate change effects on agriculture (dependent variable), correlation analysis was done. The results of correlation analysis are shown in Table 3.

Table 3. Relationships between selected characteristics of the respondents and problems faced in adaptation to climate change effects on coastal agriculture

Dependent variable	Independent variable (Farmers characteristics)	Coefficient of correlation (r)
Problems faced in adaptation to climate change effects on coastal agriculture	1.Age	-.188*
	2. Education	-.079
	3. Farm size	-.308**
	4. Farming experience	-.199*
	5. Annual family income	-.200*
	6. Training experience	-.025
	7. Communication exposure	-.132
	8. Organizational participation	-.259**
	9. Agricultural knowledge	-.321**
	10. Fatalism	-.027

** = Significant at .01 level, * = Significant at .05 level.

The coefficient of correlation indicates the linear relationship between the two variables. Out of 10 independent variables, the correlation coefficients of 6 variables were significant. These were age, farm size, farming experience, annual family income, organizational participation and agricultural knowledge. The coefficient of correlation shows that if the farmers become more aged, more experienced, have more agricultural knowledge, more organizational participation with larger farm he has more capacity to tackle the problem of climate change with both expertise and monetary backup.

The result of this study supports the previous study by Howlader, M. S., M.G.R. Akanda and A.K.M. M. Zaman [9], also explained in the articles written by Acquah and Quayum et al. [1,14] and Uddin et al. [20].

4. Conclusions and Recommendations

The study examined the problems in relation to adapt to climate change effects in Patuakhali district of coastal Bangladesh. This study has identified and characterized a number of problems to adaptation to climate change effects on coastal agriculture. Result showed that major constraints to adaptation in Patuakhali district were Unpredicted weather and high frequency of natural calamities, Non-availability of improved variety seeds at local market, Low annual family income, Lack of credit facilities, Lack of salinity tolerant varieties for different crops, Lack of Disease and insect resistant varieties, Poor fertility of soil due to salinity, Scarcity and untimely supply of farm input, Lack of information about adaptation strategies, High illiteracy rate, Low knowledge on ICM among farmers, Traditional practices/beliefs, Fatalistic behavior of the farmer, Government irresponsiveness to monitoring climate risk management programmes, Conflicts between crop farmer and fisherman for water management etc.

The paper recommends effective training and extension education, technical assistance, proper information and inputs at right time to build and strengthen the capacity of farmer to cope with adverse effects of climate change on agriculture. Therefore agricultural extension service and other stakeholders have a great duty to perform in providing training on how best to adapt to climate change effects. Government must monitor the progress and implementation phases of adaptation projects to strengthen respondents capacities.

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